WATER-RELATED INCIDENTS IN 2001 IN MARICOPA COUNTY

A Report to the Drowning Prevention Coalition of Central Arizona

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WATER-RELATED INCIDENTS IN 2001 IN MARICOPA COUNTY

SUMMARY

This report describes water-related incidents that have activated the *9-1-1* emergency system. Data in this report are derived from case reports submitted by firefighters in the Phoenix metropolitan area. In 2001 there were 135 serious water-related incidents that occurred in the metro area. Children 0-4 years of age accounted for 75 of these incidents, 57 of which occurred in swimming pools. Of these 75 children 0-4 years old, 23 are known to have died (16 due to an incident occurring in a pool). Although there have been an increasing number of children living in the area, the number of incidents in swimming pools has remained relatively unchanged since 1990.

We believe that prevention efforts have suppressed the number of incidents and immersion-related deaths. Death certificate data reveal 25 deaths of children 0-4 years of age in 2001 in Maricopa county. The drowning death rate in 2001 reached 11.1 deaths per 100,000 children. The county has not been able to maintain the relatively lower death rate noted in 1999, and the latest rate shows little change since 1990.

Two risk factors continue to be the predominant issues for drowning and near-drowning incidents: lapses in parental supervision of children in pools during the summer months and lack of adequate pool barriers throughout the year, particularly during the winter months.

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INTRODUCTION

In the mid-1980's the drowning death rate of Arizona's preschoolers ranked first in the nation.[1] Warm weather, long summers, and the presence of about 300,000 residential swimming pools make Arizona prone to water-related incidents. Furthermore, death is just one outcome of water-related incidents: in about 9% of incidents the child survives, albeit with some degree of neurologic impairment.[2]

In order to address this problem in the Phoenix metropolitan area (which is called "Maricopa County" in this report), the Drowning Prevention Coalition of Central Arizona was formed in 1988. This Coalition is comprised of municipal fire departments, hospitals, the state and county health departments, community organizations, pool builders, suppliers of pool safety equipment, parents of drowning victims, and others.

In 1988, The Arizona Department of Health Services (ADHS) established a surveillance system to monitor the water-related reports from fire departments. The fire departments usually are first on the scene of *9-1-1* calls and are able to provide information about the event. Few, if any, incidents occur without activation of *9-1-1*. The fire departments submit reports of water-related incidents on a standard form (see attachment) developed in conjunction with the Coalition. The reported data items include the age and gender of the victim, the location, and the apparent circumstances surrounding the event. The ADHS Bureau of Public Health Statistics receives and analyzes these case forms.

The following report presents the data collected for 2001, and compares the findings to those in previous years. Much of the report focuses on children under five years of age, specifically on incidents occurring in swimming pools. Also included is a graph of the rate of deaths due to child drowning in any body of water in Maricopa County.

[1] Arizona Department of Health Services. Unintentional Drowning Deaths, Arizona, 1980-1989. Office of Planning & Health Status Monitoring, October 1990.

[2] Beyda, D. and Masuello, J. Phoenix Children's Hospital. Oral communication, July 1999.

CASE DEFINITION

In this report a water-related incident is defined as an incident in which a fire department responded to a *9-1-1* emergency call. Included in the analysis is any incident in which the victim was given CPR, was not breathing, and was submerged or not struggling when retrieved from the water. (Some of these cases die the same day or at a later time; some fully recover.) Excluded from analysis is any incident that did not appear to be life threatening. For example, an incident in which a victim was struggling and did not require CPR is excluded from analysis.[3]

For consistency, one person at ADHS receives and codes the forms of each reported incident. Usually, fewer than six incidents per year are questionable as to whether the incident was life threatening. Also, calls to *9-1-1* that are canceled are not included. The data in this report generally do not include the activity of Maricopa County Sheriff's Office, which responds to incidents on the surrounding lakes, the Salt River, or the Verde River; these area popular recreational areas located just outside of the Phoenix metropolitan area.

When producing the reports for 1997 and 1998, inquiry was made to two pediatric critical care facilities (Phoenix Children's Hospital and Saint Joseph's Hospital) to ensure the accuracy of the surveillance system. Surprisingly, the fire departments under-reported 13 incident in 1997 and 7 incidents in 1998. These incidents were added to the database and analyzed in the annual reports for the respective years. However, similar checks with the hospitals have not occurred in 1999, 2000, or 2001. Also noteworthy, in 1999 the Phoenix Fire Department designated one person to be chiefly responsible for reporting water-related incidents. This step probably has resulted in more complete reporting from Phoenix beginning in 1999. Those steps are mentioned because they influence the consistency of the data reported herein.

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[3] There were many terms for the relatively minor incidents that were excluded, including: "dunking, close call, near miss." In 1999 there were 31 such cases, in 2000 there were 22, and in 2001 there were 54 excluded incidents.

FINDINGS

In 2001, the *9-1-1* emergency system responded to 135 serious water-related incidents in Maricopa County among persons of all ages. The number of incidents in previous years was 105 in 1990; 107 in 1991; 102 in 1992; 112 in 1993; 75 in 1994; 94 in 1995; 85 in 1996; 86 in 1997; 99 in 1998; 113 in 1999; and 115 in 2000. **Table 1** presents the distribution of the 135 incidents in 2001 according to the city and age of the victim.

Table 1. Water-related incidents in 2001 according to age group and city of incident in Maricopa county. Only life threatening incidents are included in the analysis.

	Years of Age of the Victim					
City of Incident	0-4	5-14	15-34	35-64	65+	**Total**
Apache Junction	4	0	0	0	0	**4**
Avondale	3	0	1	0	0	**4**
Chandler	3	0	2	1	0	**6**
Gilbert	5	0	2	1	0	**8**
Glendale	5	3	0	1	0	**9**
Mesa	10	2	1	0	1	**14**
Paradise Valley	0	0	0	0	0	**0**
Peoria	1	2	3	1	0	**7**
Phoenix	41	7	8	9	4	**69**
Rural area	0	1	4	0	0	**5**
Scottsdale	1	0	0	0	3	**4**
Tempe	1	0	2	0	0	**3**
Other & Unknown	1	0	0	0	1	**2**
All Areas	**75**	**15**	**23**	**13**	**9**	**135**

Table 2 presents the body of water of the incidents according to age group. Most incidents took place in pools. Pools, either above ground or in ground, were involved in 88 (65%) of the 135 events. Fifty-seven of the 88 incidents in pools involved children aged 0-4 years. Rivers and lakes (15 incidents) and bathtubs (9 incidents) were the next most common places for water-related incidents among all ages. Seven toddlers were trapped in buckets in 2001; with at least four incidents resulting in death. For all age groups, other bodies of water in which incidents occurred included spas (8), canal/irrigation ditches (4), fish or decorative pond (2), and two "other" bodies of water.

Table 2. Water type by age group, 2001. Only life threatening incidents are shown.

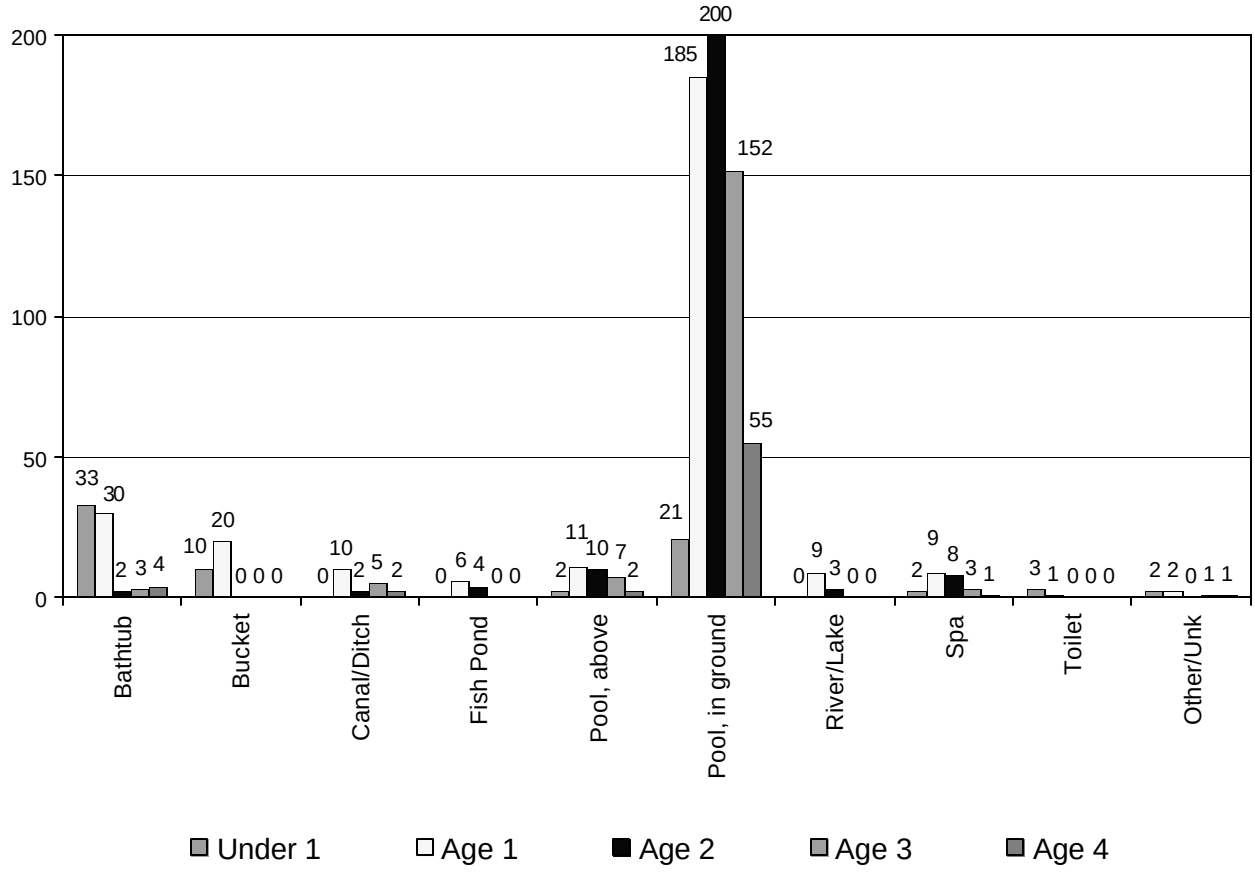
	Years of Age of the Victim					
Body of Water	0-4	5-14	15-34	35-64	65+	**Total**
Bathtub	2	1	3	2	1	**9**
Bucket	7					**7**
Canal or Irrigation Ditch		1		2	1	**4**
Fish or Decorative Pond	2					**2**
Pool, above ground	2			1		**3**
Pool, in ground	55	11	6	6	7	**85**
River or Lake	2	2	11			**15**
Spa	4		2	2		**8**
Other or Unknown	1		1			**2**
All water bodies	**75**	**15**	**23**	**13**	**9**	**135**

YOUNG CHILDREN

Children, ages 0-4 years, comprised the largest group experiencing a water-related incident. Although older individuals are equally important to consider in terms of loss of life, society generally feels a greater sense of responsibility to prevent injury to persons in the youngest, highly vulnerable, age group. The remainder of this report presents the data analyzing the findings among the 0-4 year old age group.

The distribution of cases among single ages of the 0-4 year old group is shown in **Figure 1**. Among children 1-4 years old, the overwhelming number of incidents occurs in pools. Among infants under one year of age, bathtubs are the most common water body in which incidents occur.

Figure 1. Body of water in which life threatening incidents occurred, by single age category. Maricopa County, 1990-2001.



Because most incidents for this age group occurred in pools, many of the following tables and figures are restricted to incidents occurring in pools. **Figure 2** shows the number of pool-related incidents reported over the last fourteen years. In 2001, the number of incidents remained constant with the year 2000; both experiencing 57 life threatening events in pools among 0-4 year olds. However, it is important to consider that the number of children who reside in the metro area increases every year. The calculated rate of pool incidents, expressed per 100,000 children who reside in Maricopa County, is shown in Figure 3.

Figure 2. Number of life threatening pool incidents, by year, among 0-4 year olds.

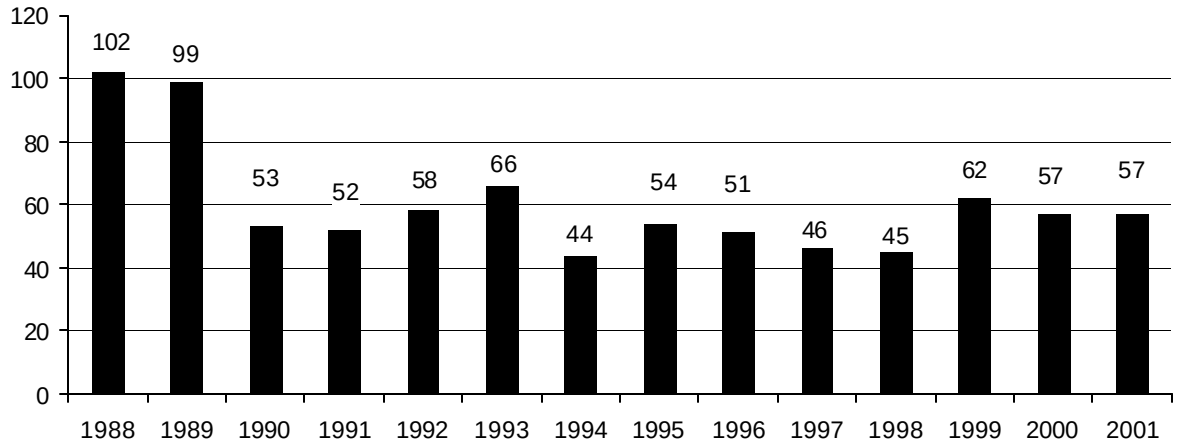


Figure 3. Rate (per 100,000 children aged 0-4) of life threatening pool incidents occurring in Maricopa County. The rate considers the increasing population of children in the County. The numerator for the rate contains incidents without regard to the county in which the child resided.

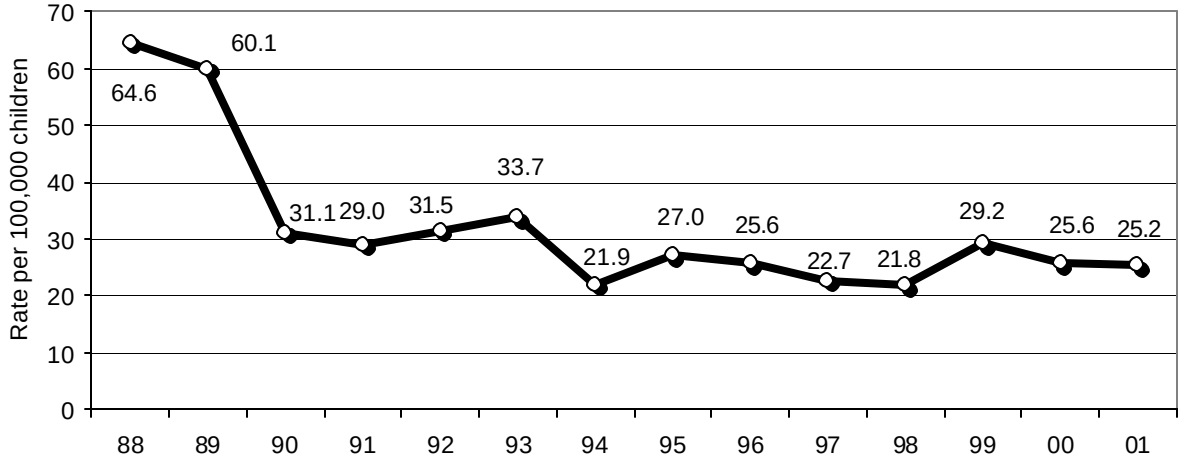
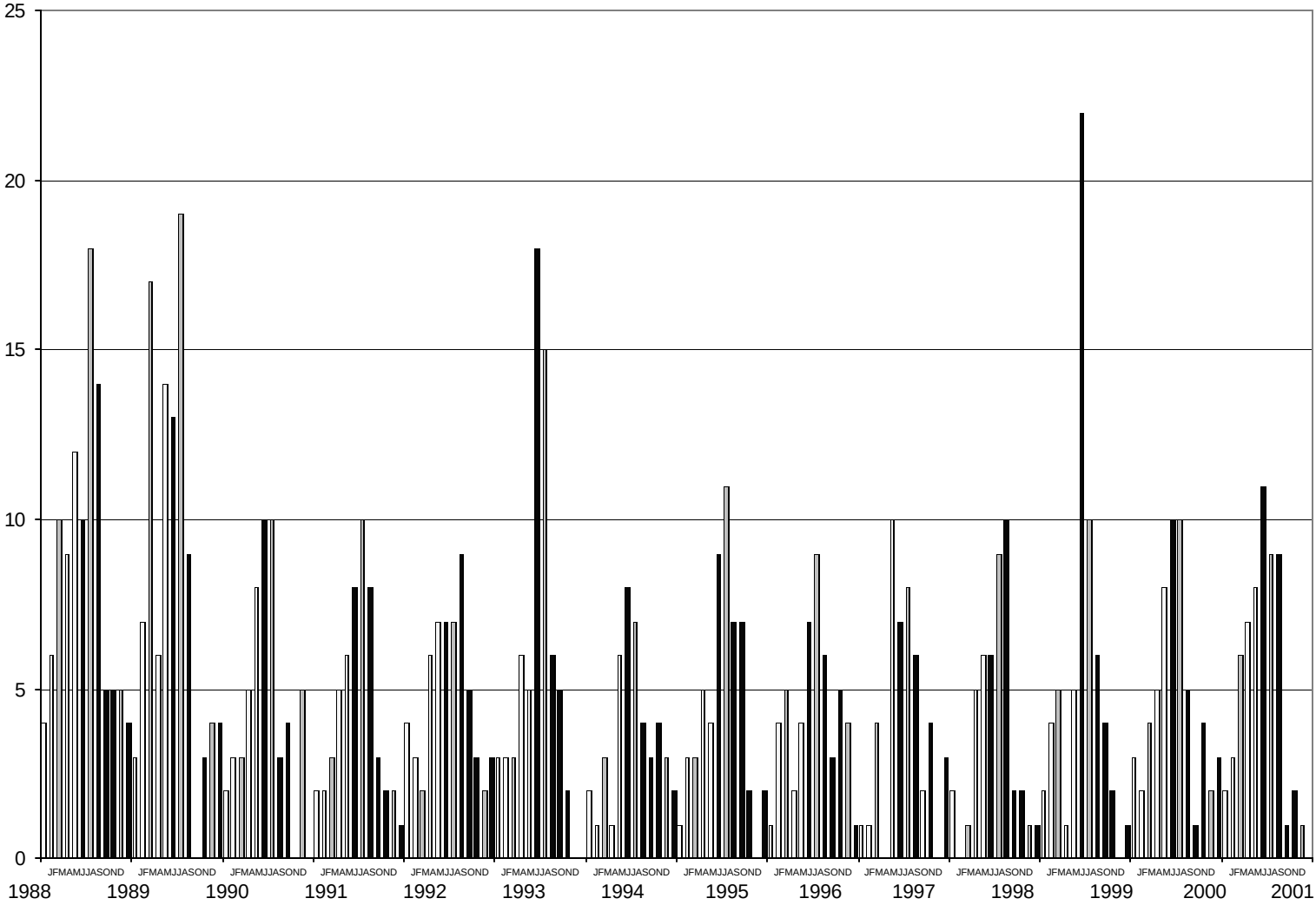


Figure 4 displays the occurrence of cases by month. The dramatic spike in incidents that occurred in June of 1999 was not repeated in 2000 or 2001. Rather, we note the typical pattern seen in previous years, with the number of pool-related incidents peaking during the summer months of June, July, and August.

Figure 4. Number of life threatening swimming pool incidents by month and year, 0-4 year olds, Maricopa County. Intense education campaigning on pool safety and barrier utilization began in June of 1989.



As presented in **Table 3**, the majority of the young pool-related victims in 2001 were male (61%). This is down from the 2000 value of 67% male victims in this 0-4 year old group.

Table 3. Gender of 57 children, 0-4 years old, involved in pool-related incidents, 2001.

Gender	Number	(%)
Male	35	61%
Female	22	39%

Race and ethnicity were poorly documented in 2001. This pattern is similar to reporting practices in previous years. These data gaps create difficulties in identifying risk factors associated with race or ethnicity. Part of the problem may be that reporting fire departments do not realize that analysis is performed on race and ethnicity as two independent variables. A cross tabulation of the available data is presented in **Table 4**.

The 2000 Census indicates that 40% of children age 0-4 residing in Maricopa County are Hispanic.[4] The proportion of Hispanic families that actually have pools is not known, but is probably less than the population as a whole.

Table 4. Selected race and ethnic characteristics of children, 0-4 years of age, involved in water-related incidents in pools in 2001.

Race/Ethnicity	Number	%
Asian	4	7%
American Indian	0	0%
Black	2	3%
Hispanic	13	22%
White	29	50%
Other	1	2%
Unknown	9	9%

[4] To calculate the percentage of Hispanic children in Maricopa County, the numerator was derived from the U.S. Census Bureau at http://factfinder.census.gov/ and the denominator was derived from the Arizona Department of Economic Security's Population Statistics at http://www.de.state.az.us/

Table 5 presents the incidents according to the body of water and the site of the 75 incidents involving children between the ages of 0 and 4. The most common site of incidence was a pool located at the victim's home (46 incidents). Four incidents occurred in the pool at a relative's home and four occurred at a friend's home. All seven bucket incidents and both of the bathtub incidents occurred at the victim's home, as did the three spa incidents. There were no canal or toilet incidents among 0-4 year olds in Maricopa County for 2001.

Table 5. The body of water according to the site of incident for children, 0-4 years of age. Life threatening incidents only, Maricopa County, 2001.

Body of Water	Friend's Home	Neighbor's Home	Other	Public/ Semi-pub	Relative's Home	Victim's Home	All Sites
Bathtub						2	**2**
Bucket						7	**7**
Canal/Irrigation Ditch							**0**
Fish/Decorative Pond					1	1	**2**
Pool, above ground						2	**2**
Pool, in ground	4		2	1	4	44	**55**
River/Lake			1		1		**2**
Spa			1			3	**4**
Toilet							**0**
Other/Unknown					1		**1**
Total	**4**	**0**	**4**	**1**	**7**	**59**	**75**

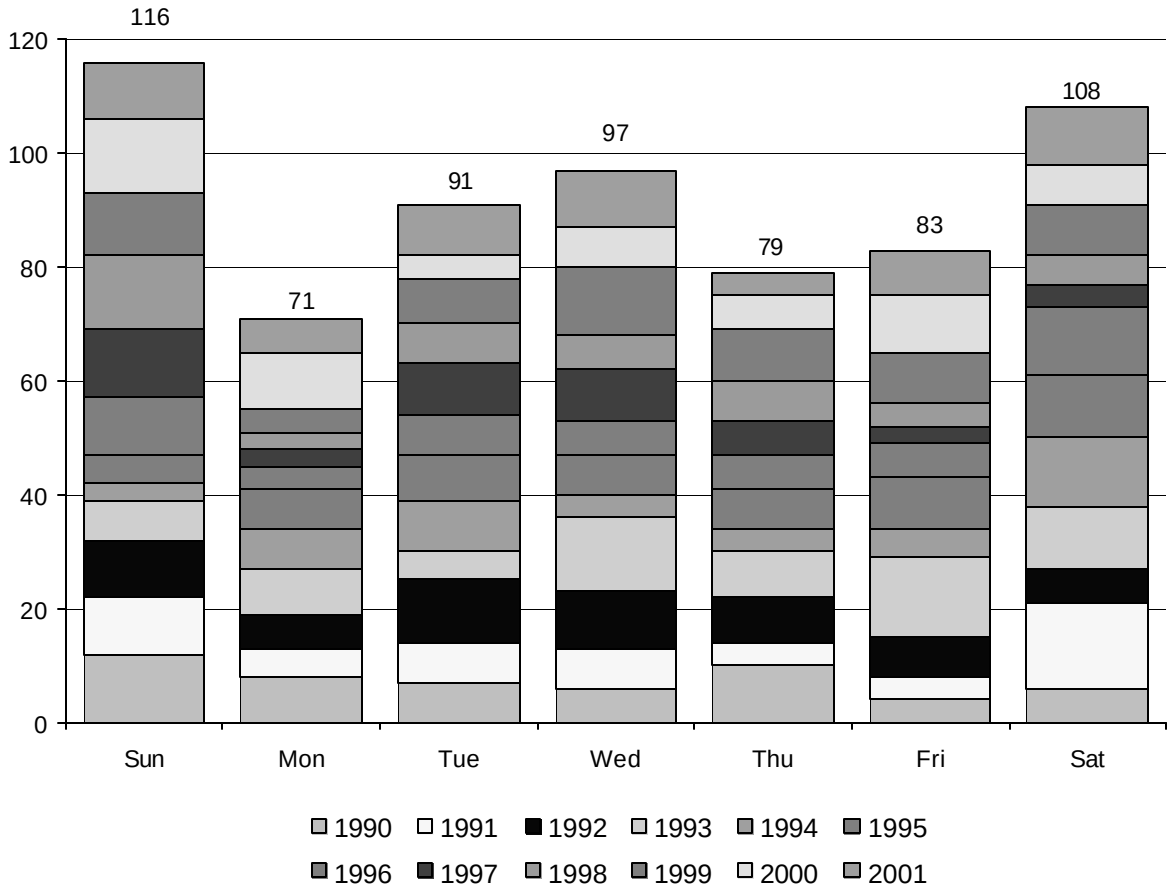
Table 6 presents the type of dwelling where the incidents took place. Forty-one of the 57 pool incidents occurred at a single family home. Thirteen (23%) of the 57 pool incidents occurred in apartments or condominiums in 2001. In past years, apartments were the location of most bathtub incidents. In 2001, apartments and single homes each had one life threatening bathtub incident involving a 0-4 year old.

Table 6. The body of water according to the type of dwelling for children, 0-4 years of age, who experienced a water-related incident in 2001.

Body of Water	Apt/ Condo	Hotel/ Motel	Single Home	Multiple Units	Trailer/ Mobile	Unk./ Other/NA	Total
Bathtub	1		1				**2**
Bucket	2		5				**7**
Canal/Irrigation Ditch							**0**
Fish/Decorative Pond			2				**2**
Pool, above ground			2				**2**
Pool, in ground	13		39		1	2	**55**
River/Lake				1		1	**2**
Spa	1	1	2				**4**
Toilet							**0**
Other/Unknown			1				**1**
Total	**17**	**1**	**52**	**1**	**1**	**3**	**72**

Figure 5 displays the occurrence of pool-related incidents by day of week. The most common day of occurrence varies from year to year. Sunday had the most incidents in 1990, 1997, 1998, and 2000. Saturday was highest in 1991, 1994, 1995, and 1996. Tuesday was highest in 1992, Friday in 1993, and Wednesday in 1999. The year 2001 demonstrated an equally high number of incidents (10) on Saturday, Sunday, and Wednesday. Incidents occurred on every day of the week. There was no day when vigilance would not have been important. The graph shows that pool incidents among these 0-4 year olds tend to occur slightly more frequently during the weekend.

Figure 5. Day of the week. Number of life threatening pool incidents among children 0-4 years old. Maricopa County, 1990-2001.



The distribution of incidents by hour of the day is shown in **Figure 6**. Not surprisingly, the incidents occurred when children were likely to be awake. The peak time for an incident in the 0-4 year old age group was in the mid-afternoon.

Figure 6. Life threatening pool-related incidents by hour of the day among children ages 0-4 years old. Cumulative numbers, 1990-2001. Maricopa County.

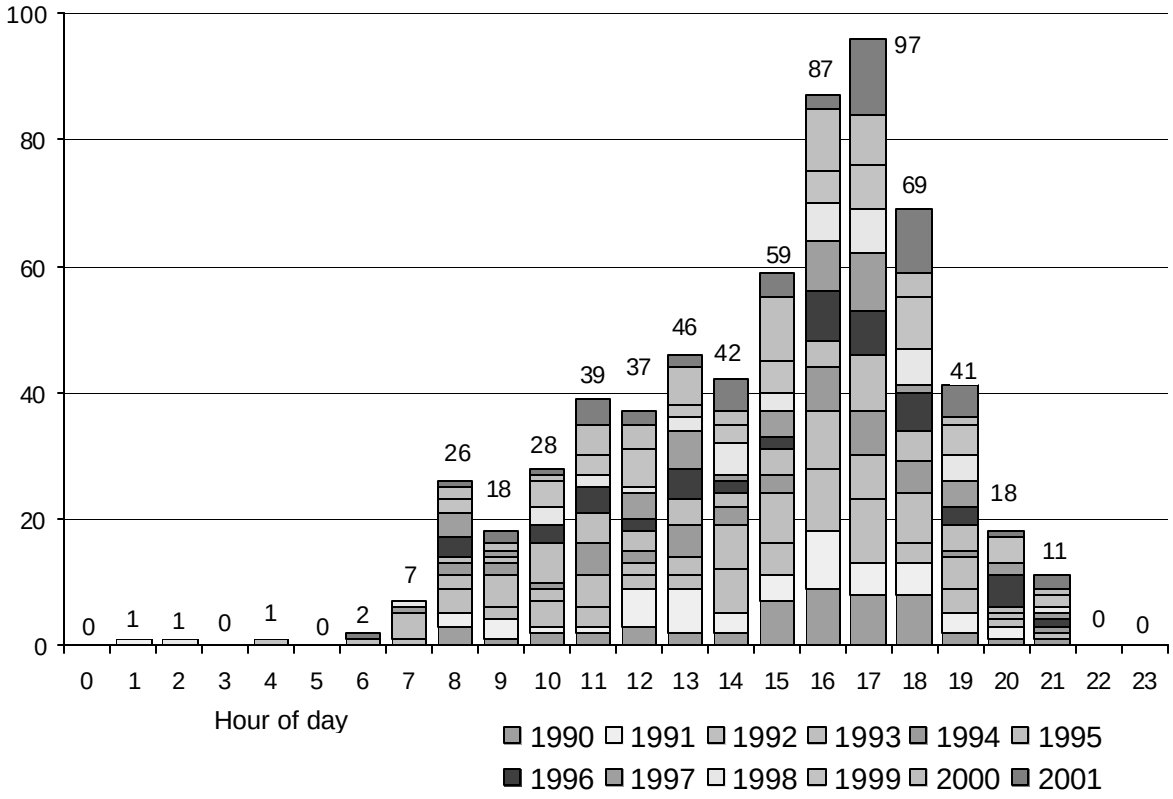


Table 7 presents information about the type of clothing worn at the time of a pool-related incident. In at least 52% of the cases, the children were not wearing swimming attire. These incidents did not occur in a swimming situation, but rather at a time when the children were not expected to be in or near the pool.

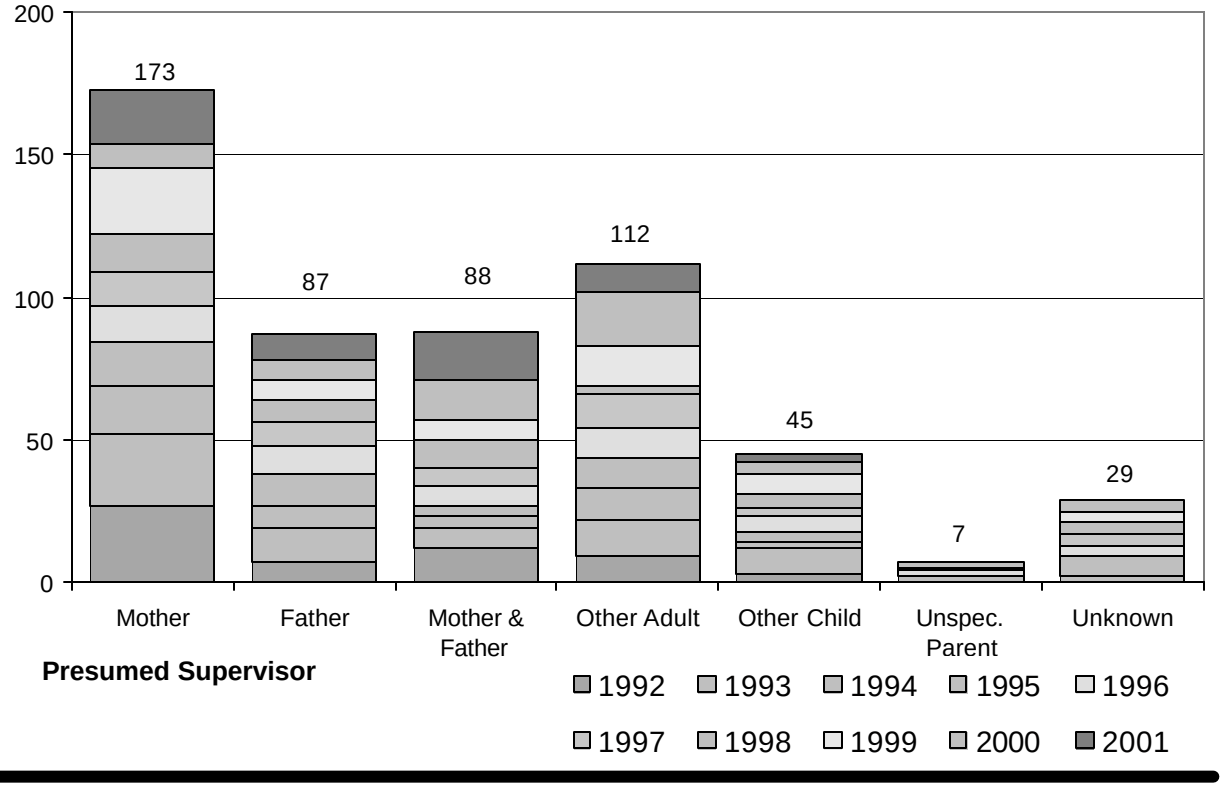
Table 7. Clothing worn by children ages 0-4 who experienced a life threatening water related incident in a pool, 2001.

Clothing	Number	%
None	2	3%
Swimwear	20	34%
Other clothes	30	52%
Unknown	6	10%

A major purpose of this surveillance system established by the Coalition is the identification of the factors surrounding water-related incidents in young children. To assist in this effort, the personnel from the responding fire departments attempt to determine the apparent circumstances surrounding each event. To gather this data, a firefighter asks about supervision at the time of the incident and looks for pool barriers that could prevent entry by young children.

Information about the supervisor of the victim at the time of incident is shown in **Figure 7**. Over the past ten years, a mother or father was supervising the child in 355 (66%) of the 541 total life threatening incidents with children 0-4 years old. In 186 (34%) incidents, the supervisor was someone other than the child's parent. This seems to be higher than the amount of time that children in this young age group spend outside the direct supervision of a parent. Thus, babysitters and other supervisors also need to be alert to the potential for a pool-related incident to occur.

Figure 7. Cumulative number of life threatening pool incidents according to the person presumed to be supervising the child, 0-4 years of age. 1992-2001.



The attributed causes of pool incidents during the combined years of 1988 through 2001 is shown in **Figure 8**. This information is classified into events that occurred during "cold" months and "warm" months. The seven "cold" months are defined as October through April and the five "warm" months as May through September.

Figure 8 reveals that during the cold months, an absence of a barrier to the pool was the leading cause of water-related incidents. During the warm months, a lack or lapse in direct supervision was the leading cause. Also, the proportion of incidents attributed to gate or latch failure is concerning. These are incidents in which the latch to the gate failed, or more commonly, in which the gate was propped open. Maintaining the integrity of the gate is an important step in preventing drowning and near-drowning incidents.

Figure 8. Attributed cause (number and proportion) of drowning or near-drowning incidents in pools among children, 0-4 years old, in Maricopa County. 1988-2001.

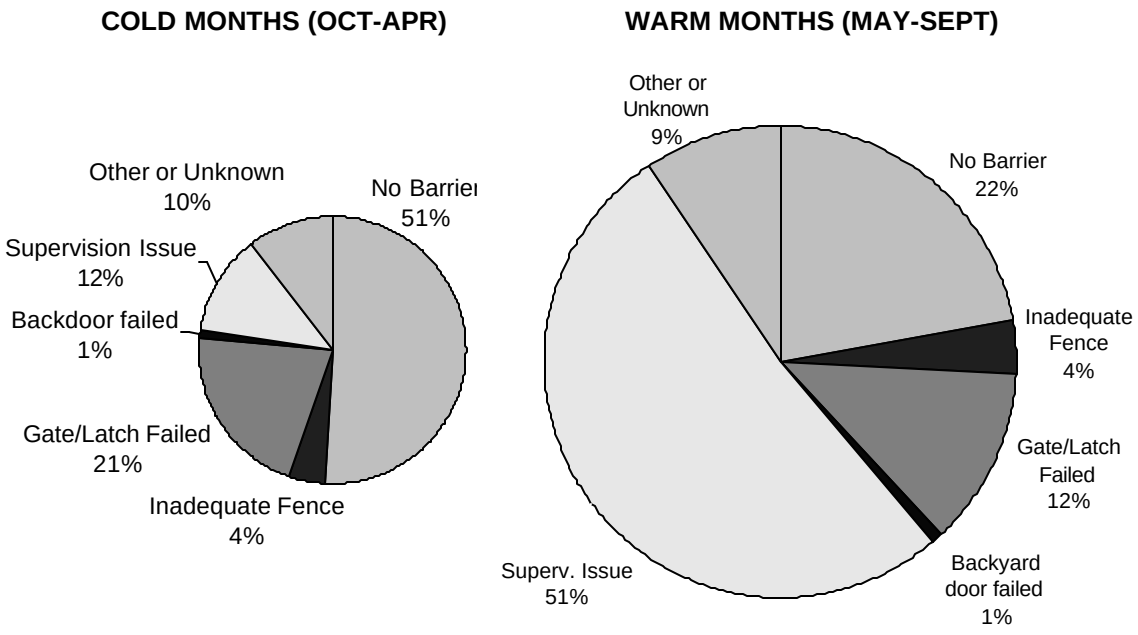
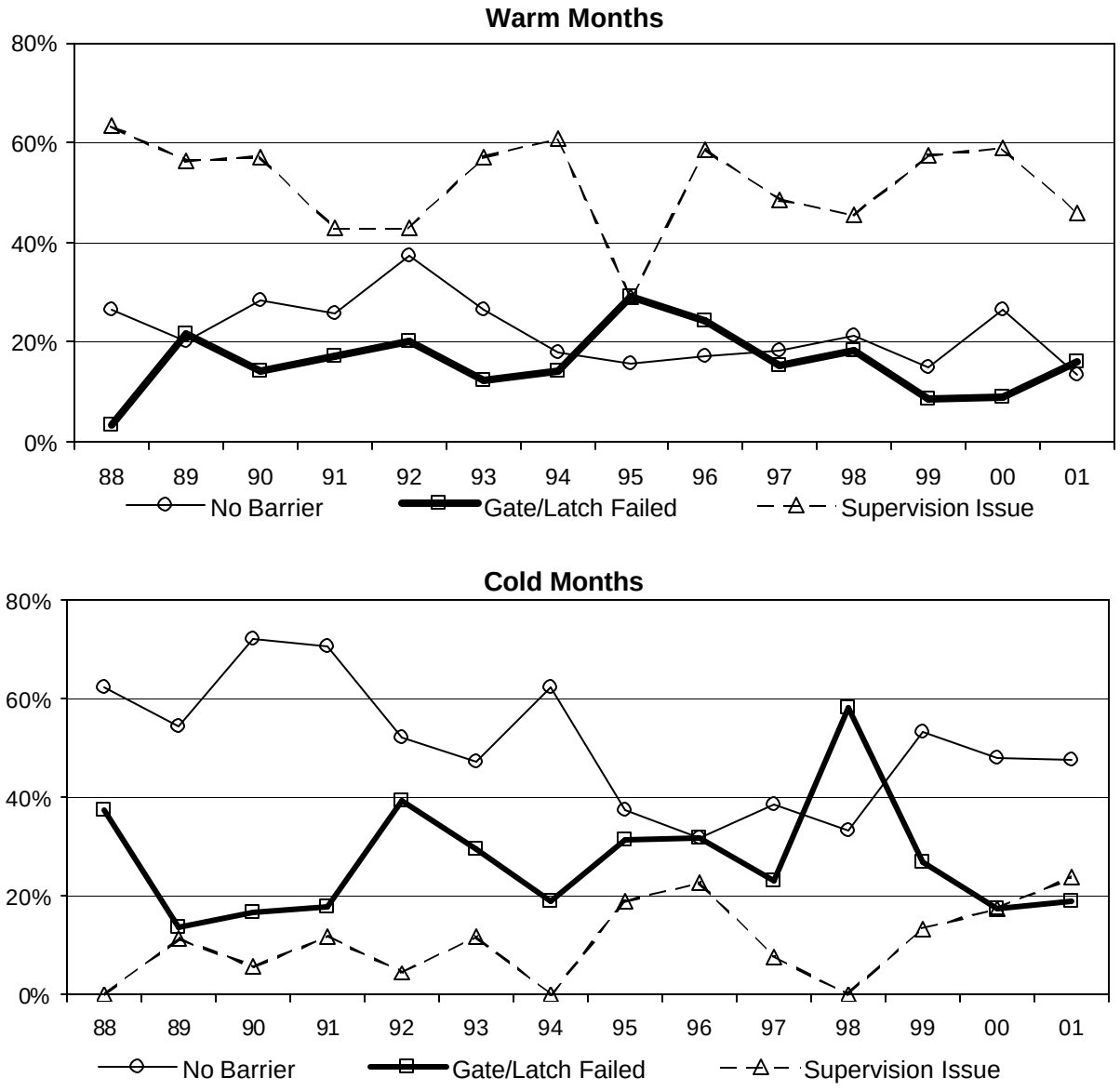


Figure 9 also presents data on the attributed cause of pool-related incidents over the fourteen year period. These charts search for trends. The data swings widely from year-to-year and the figures suggest no clear trend. That is to say, the data does not demonstrate a clear shift in the proportion of any of these three attributable causes of pool incidents.

Figure 9. Trend of attributable causes (expressed as proportions) of pool incidents in Maricopa County involving children 0-4 years of age. Trend lines for "Inadequate barrier" and "Other/Unknown" are not displayed.



OUTCOMES

The fire departments have learned that at least 23 of the 75 young children (0-4 years old) who experienced a water-related incident in 2001 have died. Sixteen children died from an incident in a pool and four died in buckets. One child died in a bathtub, one in a river or lake, and one in an undocumented water source. Of the 75 children, 21 had no noticeable impairment when released from medical supervision. There were no documented cases of neurological impairment in this age group in 2001. The outcome status of 30 children was not documented at all.

The narrative section of the incident report form often provides additional information concerning the victim's outcome. This narrative section reveals that a family member or other person often resuscitated the child at the scene by promptly administering CPR when the child was pulled from the water source. This rapid action appears to be a vital step in stabilizing the child and counteracting the detrimental effects of the submersion. However, we cannot determine whether prompt CPR leads to the survival in a vegetative state of some children who otherwise would have died.

DEATH CERTIFICATE DATA

Using death certificates as an independent data source, **Figure 9** shows the drowning death rate for children under five years of age. [5] The decline in the death rate is generally similar to the decline in the rate of pool incidents reported by the fire departments shown in **Figure 3**.

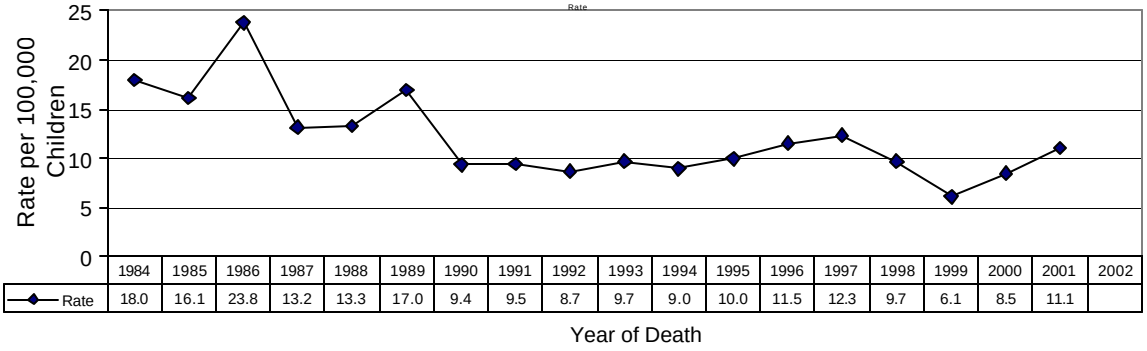
An advantage of presenting this graph is that drowning deaths of Maricopa County residents that occur in another county are <u>not</u> included here. Furthermore, in death certificate data, the outcome is known. Conversely, in the incident reports submitted by the fire departments, the final outcome of the incident is often unknown, especially if the victim is admitted to a hospital with a poor prognosis. However, a limitation of using death certificate data to describe the drowning rate is that a death in a given year may reflect a near-drowning incident that occurred in a previous year or in another county.

[5] To calculate this rate, the numerator includes Arizona residents and non-residents, age 0-4 years old, whose incident occurred in Maricopa County. The denominator, however, is the Maricopa County population of children 0-4 years old. This unconventional rate was chosen because we occasionally

Another limitation is the fact that these rates consider events that occurred in any body of water (pool, bucket, bathtub, lake, etc.), not just pools.

In 2001 the drowning rate (in all bodies of water) rose to 11.1 deaths per 100,000 children.[6] The rate has increased for the past two years from its lowest point in 1999. As a reference point, the goal *of Healthy Arizona 2010* is to reduce drowning fatalities to fewer than 0.9 deaths per 100,000 young children.

Figure 10. Drowning death rate for children, 0-4 years of age, where the occurrence of the death is in Maricopa County. Data Source: ADHS, Vital Statistics, death certificates coded with underlying cause of death as E830, E832, or E910.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rate	18.0	16.1	23.8	13.2	13.3	17.0	9.4	9.5	8.7	9.7	9.0	10.0	11.5	12.3	9.7	6.1	8.5	11.1	

DATA GAPS

As the report is currently assembled, there are a number of significant data gaps. Many of these are inherent in a system that lacks adequate funding and personnel to give proper attention to the task. The annual drowning report focuses on drowning and near-drowning incidents as reported by the municipal fire departments. There is no current checking system to ascertain that these reports are accurate in their details or inclusive of all true incidents. No cross-checks are performed with hospital emergency room data or hospital discharge data. No assurance is given that the fire department liaisons promptly record the incident and report it to ADHS. In some circumstances, the firefighter on scene may complete the incident form days or weeks after the occurrence.

encounter nonresident cases. The Drowning Prevention Coalition is focused on reducing the incidents regardless of whether the child is a county resident or a visitor.

[6] U.S. Department of Health and Human Services. *Healthy People 2010*, 2nd ed., Volume 2. Injury Prevention, Section 15-29: Reduce Drownings, page 15-40. U.S. Government Printing Office, November 2000.

Specifically identified staff members at the fire departments and local hospitals, working in close cooperation with ADHS personnel, could help alleviate these data gaps.

Since data originate from fire departments, there is underreporting of drownings on the surrounding Phoenix area lakes, the Salt River, or the Colorado River. Additionally, since the reporting fire departments are in Maricopa County, there is no reporting of drowning incidents outside of this County. Various forms of boating incidents, regardless of the water source, are not monitored either. A suggested response to this deficiency would be to involve the County Sheriff's Department and the Department of Public Safety officers, who monitor the surrounding lakes. Arizona Department of Game and Fish officers and the state and National Parks Services would also be beneficial partners in the surveillance process.

The annual drowning report focuses not only on Phoenix area incidents, but also on young children, usually under the age of 5. However, the report provides only a summary count of incidents involving older children or adults.

Lastly, the benefits of many drowning prevention measures are unknown. There is little data on the role of swimming lessons in preventing childhood drowning, as well as on the role of barriers to prevent such incidents. Other educational outlets, such as mass media campaigns, have undocumented consequences. Likewise the role of advice from pediatricians, family members, and friends is a potentially untapped source of intervention education. Strategic knowledge of how to utilize these avenues could help health educators prevent drowning in our community.

DISCUSSION

The Coalition faces various difficulties in accurately counting incidents. Surveillance systems that require active participation to register an event are susceptible to false decreases if the reporting effort becomes lax. In response to this problem, the Coalition is seeking more support for data reporting from the front line firefighters who respond to the incidents and submit the report forms. A computerized system that automatically flags water-related incidents as part of the standard reports that emergency medical providers must complete anyway would seem an efficient way to ensure complete reporting. Another option, currently in the exploratory stages, is to

develop a system that matches the incidents reported by the fire departments to hospital emergency department and inpatient records.

Since 1990, the rate of serious pool-related incidents among young children in the Phoenix metropolitan area has remained relatively unchanged. It is believed that educational messages have helped to suppress the magnitude of this problem. In 2001, there were 57 life threatening pool incidents in this age group, the same number as in 2000. The data indicate that a large part of the problem is attributable to a lapse in supervision of these young children, often when the child is already in the pool with others.

While 57 incidents involving young children occurred in swimming pools, there were 16 incidents in other bodies of water. Of special concern were the seven bucket-related incidents that occurred in 2001. Supervisors must remain constantly vigilant to the hazard of drowning anytime a young child is near water or has access to water.

A partial solution to control pool drowning is the placement of barriers around pools. The findings in this report have indicated that the largest number of incidents occurs at home, in the family pool. Arizona law now requires that all homes with a child under 6, that have a pool, must have a barrier between the house and the pool. This law applies to pools built after June 1, 1991. However, local jurisdictions can pass laws that preempt State law. The State law specifies that fences, motorized safety pool covers, or self-latching doors leading to the pool may be used as a barrier. The law specifies these barriers in term of height, openings, and gate latches capable of preventing entry by small children. Barriers would appear to be most effective in reducing incidents occurring in cold months, but also might reduce incidents occurring in warm months.

Even with the placement of barriers, nothing can substitute for proper supervision. The data suggest that the prevention message can be customized to the season of the year. Supervision is particularly important in the warmer months, when parents are with their children around the pool. This report identifies the mid-afternoon hours as a crucial time for watching children in order to prevent water-related incidents. The Coalition believes that a combination of pool barrier and supervision remains the key to the prevention of drowning tragedies.

The support of radio, TV, and newspapers in calling attention to this problem has encouraged the Coalition. These resources play a crucial role in educating new parents who might not appreciate the risk of a child drowning in Maricopa County.

SPECIAL SECTION

by Matthew Nutter, MPH Intern

HEALTH FRAMEWORK ANALYSIS

To better recognize the components of drowning intervention, and their role in educating the general public, relevant health frameworks need to be identified and applied. For this 2001 report, several such frameworks and models were analyzed for their relevance and usefulness. As an injury incident, drowning has elements that describes the physical event. However, there is also a very prevalent societal aspect to the public's perception and attitude toward drowning. The chosen frameworks need to address both physical and social variables.

To this end, I chose two models. The Health Belief Model incorporates the societal aspect of drowning injury. Concurrently, the Haddon Matrix analyzes the physical event. These two models are explained in greater detail in the following sections. General guidelines for drowning prevention and injury intervention conclude the 2001 report.

THE HEALTH BELIEF MODEL

The Health Belief Model looks at an individual's perceptions of personal susceptibility and the severity of the disease, incorporates demographic variables and cues to action, and evaluates perceived benefits and hindrances to taking preventative action. The cumulative effects of these variables determine the perceived threat of the disease and the subsequent potential for taking preventative action steps. See Appendix A for a diagram of the Health Belief Model and its application to drowning.[7]

The first stage identifies individual perceptions of susceptibility to and the severity of drowning. This is asking, "What is the likelihood that I, or someone I care about, will drown?" and then "If they drown, what would the severity of the situation be?". For drowning, the severity can vary from a frightening experience to a traumatized fear of water to neurological impairment to death.

[7] Bowes, J.E. (1997, December). Communication and Community Development for Health Information: Constructs and Models for Evaluation. Seattle, WA: National Network of Libraries of Medicine, Pacific Northwest Region.

The second stage evaluates modifying factors. Demographic variables, such as age, race, gender, and socio-economic status are factors that should be evaluated for their potential role in modifying drowning risk factors. A large medium to be evaluated for drowning is the cues to action. What impact do public education campaigns, advice from friends or pediatricians, newspaper articles, or actually experiencing a drowning have on an individual's perception of drowning? These modifying factors, combined with the individual perceptions, cumulatively determine an individual's perceived threat of drowning.

Added to the perceived threat are the perceived benefits and barriers to taking preventative action against a potential drowning incident. This evaluation looks at the benefit that would come to the individual by paying certain time, monetary, or lifestyle dues; and balancing subsequent benefits against the cost or barriers to achieve such rewards. The final analysis is weighing these benefits/barriers with the perceived threat to ultimately determine the likelihood of an individual taking preventative action against drowning.

More thorough evaluation and utilization of these models is of particular importance to health educators and other persons who plan drowning intervention strategies. Proper assessment of the public perception on drowning should dictate the direction and messages of education and prevention efforts. Incorporating cultural sensitivity (demographic variable of Health Belief Model) should be of particular relevance in our society. For example, one of the current prevention slogans, "Two seconds is too long", is roughly translated into Spanish as the contradictory statement: "You have a enough time".

HADDON MATRIX

To compliment the Health Belief Model, I also assessed the Haddon Matrix for its contribution to drowning analysis. In the early 1970's, William Haddon published his views on injury epidemiology and proposed a model to effectively analyze injury incidents. This model, the Haddon Matrix, allows each facet of an injury event to be inspected. The three stages of analysis are the pre-event, during the event, and post-

event. In each stage, the host, the environment, and the vector are analyzed for their role in the event.[8]

Haddon Matrix	Agent	Host	Environment	Vector
Pre-event				
Event				
Post-event				

The Haddon Matrix is useful to scrutinize drowning incidents. In unintentional drowning, the agent is submersion. In some cases, another agent may lead to the submersion; for instance, slipping and falling unconscious in the tub leading to death by drowning, a car accident resulting in a victim being submerged in a lake, or a homicide involving intentional drowning. These would have other agents that should also be analyzed as part of the Haddon Matrix.

For drowning, the host is the victim. In each stage, the actions and positioning of the victim are identified. The environment describes the circumstances surrounding the incident. For drowning incidents, the environment may include such things as a telephone call, a parent doing yard work, lots of kids in a pool, a gate propped open, or no fence around a pool. Lastly, the vector is the water source itself. The water may be choppy in a pool full of kids, murky in a lake, overfilling in a bathtub, or raging in a flowing river.

The following two charts are examples of the Haddon Matrix applied to drowning events. The situational elements depicted for each role player, at each stage, are drawn from several incidents which occurred in 2001.

Example 1	Host	Environment	Vector
Pre-event	Child sent to play in backyard	Parent doing yard work; Pool gate open	Parents move into house with pool before child has learned to swim
Event	Falls into in-ground pool	Telephone call distracts parent	Not shallow enough for victim to stand

[8] Haddon, W. (1973). Energy damage and the ten countermeasure strategies. The Journal of Trauma, 13 (4), 321-331.

Post-event	Dies	Parent does not return for 5 minutes	Pool is drained

Example 2	Host	Environment	Vector
Pre-event	One of many children at A party	Parents congregated at picnic tables	Choppy waters due to high activity
Event	Gags on a mouthful of water; sinks	Victim is not missed for several minutes	Nighttime visibility limited
Post-event	Pulled off Bottom of pool; CPR given	Firefighters are delayed in finding address	Better underwater lighting

This detailed dissection of hypothetical drowning events gives an incident investigator or health educator a breakdown of what could go wrong and where it might go wrong. The next step is to address the problematic stages and to modify them to prevent a similar occurrence in the future. To address this follow-up stage, Haddon proposed ten countermeasures to prevent, or react to, an injury event (see Appendix B). Eight of the countermeasures are primary response efforts, aimed at preventing the incident before it ever occurs. One countermeasure is a secondary effort, aimed at countering the damage done by the hazard. The final countermeasure is a tertiary effort, aimed at stabilizing, repairing, and rehabilitating the effects of the hazard.

As part of a Haddon Matrix analysis, 45 drowning incidents from 2001 were analyzed. The results were tabulated and theoretical Haddon countermeasures were suggested. The outcomes of this project showed that more dedicated supervision and proper barrier performance or installation could have prevented a majority of the drowning incidents. This agrees with the literature and the outcomes were not surprising. However, this study may help reinforce prevention measures aimed at increasing parental supervision of their children around water and installing proper barriers around hazardous water sources.

DROWNING PREVENTION AND INTERVENTION RECOMMENDATIONS

The recommendations for drowning prevention and intervention suggested by the Haddon Matrix countermeasures are remarkably similar to those issued by the Drowning Prevention Coalition of Central Arizona, the Arizona Department of Health Services, the American Red Cross, and the Centers for Disease Control and Prevention. Many of their cumulative suggestions are listed below. The chances of you or your children becoming drowning or near-drowning victim are decreased significantly by following a few simple safety tips[9]:

- Whenever young children are swimming, playing, or bathing in water, make sure an adult is constantly watching them. This means that the supervising adult should not read, play cards, talk on the phone, do yard work, or do any other distracting activity while watching the children.
- Never swim alone or in unsupervised places. Teach children to swim with a buddy.
- Keep small children away from buckets containing liquid, especially children less than two years old. Five-gallon industrial containers are a particular hazard. Be sure to empty buckets when finished with their use.
- Never drink alcohol while swimming, boating, or water skiing. Never drink alcohol while supervising children. Teach teenagers about the danger of drinking alcohol around water.
- The role of swim lessons for young children is unresolved. Data are not available to determine whether early-age aquatics programs change the risk of drowning. The decision to offer lessons must be individualized, and take into account the child's developmental stage and the quality of the instruction. Research on this topic is needed.[10]
- Learn cardio-pulmonary resuscitation (CPR). This is particularly important for pool owners and individuals who are frequently around water.

[9] National Center for Injury and Prevention Control. (2002). Drowning Prevention. Centers for Disease Control and Prevention. Accessed from the World Wide Web April 2, 2002. http://www.cdc.gov/ncipc/factsheets/drown.htm

- ?? Do not use air-filled swimming toys or aids in place of life jackets or life preservers with children. Such items are not recognized as personal floatation devices (PDF's), can give both children and parents a false sense of security, and possibly increase the risk of drowning.
- ?? Check the water depth before entering. The American Red Cross recommends a minimum depth of 9 feet for diving or jumping.
- ??

If you have a swimming pool at your home:

- ?? Install a four-sided isolation fence around the pool and swimming area. The fence should be at least 4 feet tall and should completely separate the pool from the house and play area of the yard. The gate should be self-closing, not readily propped open, and should be self-latching upon closure. Do not place climbable objects next to the fence that may allow a child to climb over the fence. This includes patio chairs, patio tables, large toys, pool pumps, and other large objects.

- ?? Prevent children from having direct access to a swimming pool. Backyard doors, patio doors, doggie doors, and windows that open into a pool or spa area should be locked and should not be easily opened by young children; unless a separate inner fence separates the water source from the house.

- ?? Install adequate underwater lighting in your pool to allow for rapid identification of a struggling or submerged swimmer.

- ?? Install a telephone near the pool. Know how to contact local emergency medical services. Post the emergency number, *9-1-1*, in an easy-to-see place.

- ?? Learn CPR.

- ?? While there are many individual recommendations listed here, they can predominantly be grouped into four prevention points: dedicated supervision,

[10] Sources: Gladish, K. (2002). Swimming Programs for Infants and Toddlers (letter). Pediatrics, 109(1). 168-169. See also Washington, R.L. (In Reply).

secure environment, rapid medical response, and personal responsibility with alcohol.[11]

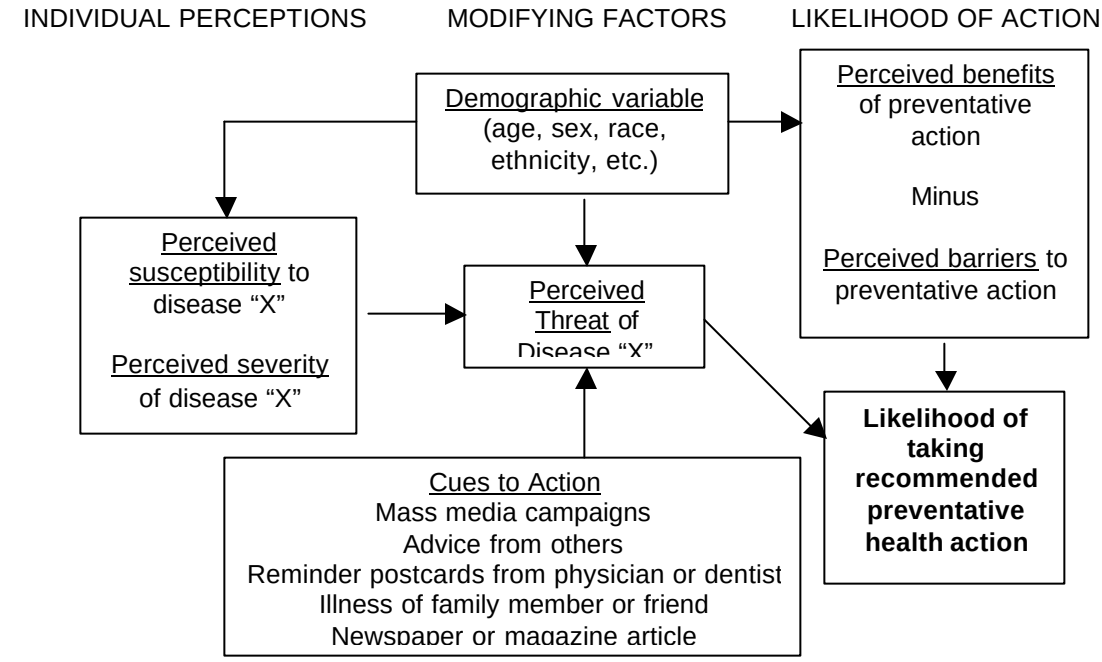
OTHER PREVENTION MEASURES

Proper supervision, adequate barriers, and education are excellent individual measures that can be taken to prevent drowning. However, there are also community wide prevention efforts that should be considered. One such effort is relevant legislation and subsequent enforcement. Many cities in the Phoenix metropolitan area enacted barrier code legislation in the early 1990's (Flood, 1991). However, the City of Gilbert failed to pass their barrier code laws in the fall of 2001, and to date does not have any fencing laws. In many cities, the barrier codes only apply to pools installed after the legislation was passed. Another effort would be to enact legislation that requires isolation fencing on all pools, regardless of their installation date. Additionally, some city codes merely require a four-sided fence around the pool; it does not have to be an isolated fence. For these cases, the block or wood fence around the entire yard is adequate, with no inner fence being required. This too could be addressed by new legislation in an effort to diminish the hazards of backyard swimming pools.

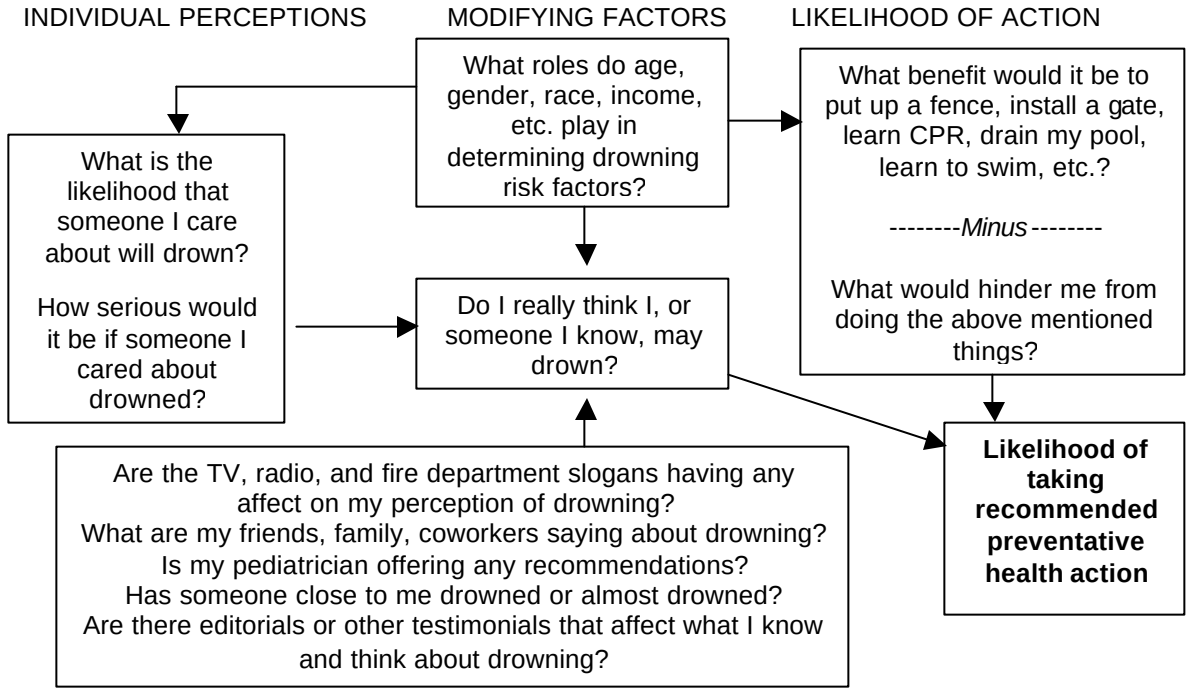
The follow up on creating legislation is enforcing the codes. Currently the State of Arizona monitors public and semi-public pools for barrier maintenance and conformity. This includes park pools, community pools, hotel/motel pools, and apartment pools. Fire departments can also inspect public and semi-public pools, and have the right to evacuate and close any pool not in conformance. However, these public and semi-public pools may only be inspected once or twice a year. No inspection is made on private pools, other than immediately after the pool is built. Inadequate manpower and money do not make it reasonable to check all the pools in the Valley on a routine basis, but perhaps this issue should be given more emphasis as a preventative measure.

[11] Committee on Injury and Poison Prevention (1993). Drowning in Infants, Children, and Adolescents. Pediatrics, 92 (2), 292-294.

Health Belief Model[12] Appendix A



Health Belief Model, applied to drowning assessment



[12] Source: 'Communication and Community Development for Health Information: Constructs and Models for Evaluation' by John E. Bowes, Review prepared for the National Network of Libraries of Medicine, Pacific Northwest Region, Seattle, December 1997. Jbowes@u.washington.edu

Haddon Countermeasures…[13] Appendix B

As applied to drowning

1. Prevent the creation of the hazard in the first place.
   There are times when it makes sense not to build a swimming pool. If, for example, a woman runs a day-care facility in her home, she may not want to build a swimming pool in her backyard.

2. Reduce the amount of hazard brought into being.
   The number, size, or depth of bodies of water can be reduced, or the size of boat motors could be reduced, thereby reducing the risk of boaters falling overboard or swimmers being struck. Swimming pools can be emptied when not in use.

3. Prevent the release of the hazard that already exists.
   Closing pools and public beaches where no lifeguard is on duty may deter swimmers and reduce their risk of drowning. Floatation gear can be worn on or near bodies of water.

4. Modify the rate or spatial distribution of release of the hazard from its source.
   Bathroom faucets can be modified to avoid the rapid filling of bathtubs that may increase children's risk of drowning. Water at dams can be released in small quantities rather than abruptly in amounts that can swamp a small boat downstream.

5. Separate, in time or space, the hazard and that which is to be protected.
   Playgrounds can be constructed at a distance from streams or other unguarded bodies of water.

6. Separate the hazard and that which is to be protected by interposition of a material barrier.
   Non-scalable fences and childproof gates can be constructed around swimming pools, water-filled quarries, and docks. Wells and irrigation and drainage ditches can be covered in such a way that children cannot enter them.

7. Modify relevant basic qualities of the hazard.
   One option might include "safer" swimming pool designs (e.g. non-slip decks, steps, ladders, and edges; softer surfaces; larger shallow ends; and well-marked deep ends). Bathtubs might also include non-slip pads to prevent small children and the elderly from falling and drowning.

8. Make what is to be protected more resistant to damage from the hazard.
   Training more people to swim strictly for the purpose of reducing drowning should be considered with some caution. Both swimmers and non-swimmers drown. Trained swimmers may be more likely to exercise their skill and increase their exposure to the hazard. Another option might include monitoring and/or prohibiting alcohol intake in and around recreational water areas.

9. Begin to counter the damage already done by the environmental hazard.
   Lifeguards can be placed in more areas of potential water hazard. Underwater lights in pools, lights on boats, and visible swimwear can enhance the identification of persons in trouble in water. Life preservers and lifeboats can lower the risk to the rescuer. Training citizens in CPR and proper extrication of drowning persons may minimize injury.

10. Stabilize, rehabilitate, and repair the object of the damage.
    Special rehabilitation of persons with brain damage from a near-drowning (anoxia) event can help them adapt more readily to their disability.

[13] Adapted from editorial by Haddon, W. (1970). American Journal of Public Health, 60(12), 2229-2234. Originally published in (1970) Technology Review, 72(7), Massachusetts Institute of Technology.

REPORT OF DROWNING OR NEAR-DROWNING IN ARIZONA – 2001

_____ _____:_____ _____ ____ **INCIDENT #** _____

DATE OF INCIDENT (MM/DD/YR) **HOUR** (24:00) **AGE** (yrs) **SEX**

PLAT # or ZIPCODE: _____

_____ **Fire Dept.**
(Reporting agency)

CITY OF INCIDENT:
( ) Chandler ( ) Mesa ( ) Rural area
( ) Gilbert ( ) Peoria ( ) Scottsdale
( ) Glendale ( ) Phoenix ( ) Tempe
( ) Other:_____

HISPANIC: ( ) Yes ( ) No ( ) Unk.

RACE: ( ) White ( ) Amer. Indian
( ) Black ( ) Unknown
( ) Other: _____

WATER TYPE:
( ) Pool--in ground ( ) Spa
( ) Pool--above ground ( ) Bathtub
( ) Canal or Irrig. Ditch ( ) Toilet
( ) Other: _____

SITE OF INCIDENT: (at whose home?)
( ) Victim's Home ( ) Neighbor's "
( ) Relative's " ( ) Friend's "
( ) Other: _____

TYPE OF DWELLING:
( ) Single Home ( ) Apt/Condo
( ) Hotel/Motel ( ) Other: _____

ATTIRE OF VICTIM: ( ) Swimwear
( ) None ( ) Other Clothes

ACTIVITY AND LOCATION OF VICTIM IMMEDIATELY PRIOR TO INCIDENT:
_____
_____

SUPERVISOR(s) AT TIME OF INCIDENT:
( ) Mother ( ) Father ( ) N/A
( ) Other (Specify) _____
Age of this person _____

ACTIVITY AND LOCATION OF SUPERVISOR IMMEDIATELY PRIOR TO INCIDENT:
_____
_____

STATUS OF VICTIM WHEN FOUND IN WATER:
( ) Submerged ( ) Floating
( ) Struggling ( ) Unknown
( ) Other: _____

RESPIRATORY EFFORT WHEN PULLED FROM WATER:
( ) Present ( ) Absent

ESTIM. DURATION OF ANOXIA: __ _____

DID RESCUER/ BYSTANDER(S) PERFORM CPR?
( ) Yes ( ) No ( ) Unknown
Done right? Comment: _____
_____

LENGTH OF RESIDENCE AT THIS HOUSE (if applicable)? _____

IS THERE A FENCE OR BARRIER?
( ) Yes ( ) No ( ) Unknown
Describe:_____

METHOD OF ACCESS TO POOL OR SPA:
( ) Supervisor allowed child into pool or deck area
( ) No barrier -- child wandered in
( ) Climbed (specify): _____
( ) Child entered unsecured gate
( ) Child entered secured gate
( ) Other: _____

WOULD AN <u>INNER FENCE</u> AROUND THE POOL HAVE PREVENTED THIS INCIDENT?
( ) Yes ( ) No
( ) Unknown ( ) N/A

DISPOSITION:
( ) DOA ( ) Died in E.R.
( ) Treated As Outpatient
( ) Admit to: _____

FOLLOW-UP: (Date pt was last seen)
( ) Died _____ / _____ / _____
( ) No Impairment _____ / _____ / _____
( ) Impairment _____ / _____ / _____

DESCRIBE THE APPARENT CIRCUMSTANCES (how/why it happened; how child was found & revived): _____ (Initials) _____
_____
_____ (Today's Date)
_____ _____
_____

K:\DROWN\FF2001; fax completed forms to ADHS (602)-364-0082